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of sensitiveness in the blue (in the neighborhood of  $\lambda = 477 \mu\mu$ ), the other in the yellowish-green (in the region of  $\lambda = 534 \mu\mu$ ). The latter type is found in *Chlamydomonas*, *Daphnia*, the larvæ of barnacles and other organisms; the former type exists in *Euglena*, *Eudendrium*, the seedlings of oats and others.

It seems of interest to call attention to the fact that according to the measurements of Trendelenburg the visual purple in the eye of the rabbit is bleached most rapidly by light of the wave-length  $\lambda = 536 \mu\mu$ . As Kuehne had already shown, visual purple is not affected by red light, and only feebly by yellow light. The relative efficiency of different parts of the spectrum for the heliotropic reactions of *Chlamydomonas* coincides, therefore, approximately with the relative bleaching power of rays of different wave-lengths for visual purple. This makes it almost appear as if in the one group of organisms, namely, those which behave like *Daphnia* or *Chlamydomonas*, the heliotropic reactions were determined by a substance or by substances which behave in regard to photosensitiveness like visual purple; and which may possibly be identical with visual purple.

This assumption allows us to explain the heliotropic reactions of lower organisms without arbitrarily ascribing to them sensations of brightness the existence of which can in their case not be proved. And, furthermore, when the heliotropic effect of rays of different wave-lengths upon lower organisms is found to run parallel to their effect upon the bleaching of visual purple (as it does in *Daphnia* and *Chlamydomonas*) it seems more rational and promising to conclude that the heliotropism in these cases is caused by a substance or substances which behave photochemically like visual purple than that these lower organisms suffer from total color-blindness. We have already shown in our first note that the theory of heliotropic orientation is independent of the relative efficiency of different wave-lengths.

We may summarize the results of our experiments in the following way:

1. The validity of the Bunsen-Roscoe law for the heliotropic reactions of certain (and possibly all) plants and animals suggests that

these reactions are due to a chemical action of the light.

2. There seem to exist two types of heliotropic substances, one with a maximum of sensitiveness (or absorption) in the yellowish-green (near  $\lambda = 534 \mu\mu$ ) and the second with a maximum of sensitiveness in the blue (near  $\lambda = 477 \mu\mu$ ). Visual purple is a representative of the former type.

3. The photosensitive substance of the visual purple type occurs in the protozoan *Chlamydomonas*, which is usually stated to be a plant, in *Daphnia* and many other organisms. The photosensitive substance with the maximal sensitiveness in the blue is found in *Euglena*, in many plants and in certain animals, *e. g.*, *Eudendrium* and probably others.<sup>5</sup>

4. It would, therefore, be wrong to state that the one type of photosensitive substances is found exclusively in plants and the other exclusively in animals. As a matter of fact they are distributed independently of the systematic boundaries between the two groups of organisms.

5. It is immaterial for the theory of heliotropism to which of the two types the photosensitive substance in any given heliotropic organism belongs.

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SECTION M, AGRICULTURE

THE first meeting of Section M, Agriculture, of the American Association for the Advancement of Science, was held in the Engineering Building of the University of Pennsylvania, Philadelphia, December 30, 1914.

The inauguration of the new section was particularly auspicious, and the large attendance was encouraging as indicating wide interest. Dr. Charles W. Eliot, president of the Association, presided at the opening of the meeting, and in a brief address called attention to the great importance of the agricultural industry, and expressed

<sup>5</sup> This seems to be indicated by the work of Parker and his pupils.

his gratification at the provision of the section. It is high time, he said, that we began to attend to the building up of American agriculture, and to recognize its basis in science. He expressed his special interest in the teaching of agriculture on account of the opportunity it offered for furthering the teaching of natural sciences in the schools. This, he declared, is the great reform needed in American education. The popular interest now aroused in agricultural teaching offers an entering wedge in this direction, and gives hope for the accomplishment of even greater reforms. Country-life development Dr. Eliot pronounced "one of the greatest humanitarian movements of this age." Our race can not endure urban life and the factory system, he said; the ill effects of it have already been seen. "Hence anything that leads men into the country where they may lead a wholesome existence is contributing to a necessarily humanitarian movement."

These remarks furnished an appropriate introduction to the vice-presidential address of Professor L. H. Bailey, on "The Place of Research and of Publicity in the Forthcoming Country Life Development." The address was essentially a plea for the principles of democracy, approached from the standpoint of the public service institutions for agriculture, and especially the new national work for agricultural extension.

The other feature of the meeting was a symposium devoted to "The Field of Rural Economics." This was participated in by four speakers, who dealt with several phases of the general subject. In opening the subject, Hon. Carl Vrooman, Assistant Secretary of Agriculture, discussed "Rural Economics from the Standpoint of the Farmer." He corrected some of the false impressions as to the advantages of high acre yields, pointing out that the plain business question is not how much the farmer could produce if he had no regard for the cost, but how much he can afford to produce under present American conditions. He showed by statistics that the largest crops do not necessarily mean the largest net income to the farmer, and that in years of relatively small production he often realizes quite as much from his crops as in years of maximum yield.

Secretary Vrooman laid much emphasis on the importance of the problems of distribution and marketing, enforcing his remarks by illustrations from his own experience as a farmer. While admitting the necessity for middlemen and other intermediaries, he protested against any allied in-

terest taking more than a legitimate profit from the farmer. He declared that the average farmer is only making wages: he is not making a profit over his wages and the interest on his investment. Until the problems of agricultural economies are solved there is little encouragement for him in attempting to raise larger crops. "Economic justice to the farmer and producing classes," he said, "must be the basis of the higher civilization which we picture."

In discussing "Credit and Agriculture," Professor G. N. Lauman, of Cornell University, maintained that in this country credit has not been generally available to the farmer except at a considerable premium, and that in order to develop American agriculture and rural life it must be made feasible for a man to be successively a farm laborer, a farm renter and a farm owner. Short-time credit was held to be a distinctly local matter. The community should rally all its capital to develop itself, and should organize to furnish the basis for a closer association between itself and existing banking and credit facilities. The great social and ethical gains from the small credit unions of Europe was explained, especially in helping the small farmer.

In order to bring outside capital into agriculture it is necessary to meet the demands which such capital makes. Credit, it was declared, "has no better basis than farm values made fluid." Rightly developed, bonds based on land mortgages have no superiors in the investment field. These, it was explained, should be of small enough denominations to be accessible to all classes and available on all exchanges. But the prevalent machinery for this is too expensive a burden on agriculture.

Professor Lauman did not advocate leaving the problem to either the government or to private capital for solution, but urged organization. "If agriculture organized to make it possible to demand the lowest rates of interest the market affords, can not live and develop, not even state aid will prevent its ultimate decay."

In a paper on "Marketing and Distribution Problems," Mr. C. J. Brand, of the Department of Agriculture, presented the needs of the farmer in the way of assistance in establishing a market system which will return to him the true value of the various crops he produces, minus reasonable charges for handling, transportation and the legitimate profits of middlemen. He outlined the various lines of study which are being pursued by the Office of Markets and Rural Organization. These are concerned, in part, with a study of conditions

as they actually exist over the country in the handling and marketing of cotton, grain, live stock, meat and meat products, fruits, vegetables, dairy and other products, followed through from the producer to the consumer, with statistical studies of supply and demand. Market grades and standards are also being investigated, with the object of effecting greater uniformity; and transportation and storage, as to methods, the adequacy of facilities, and the relation of warehousing, refrigeration, etc., to prices and to stabilizing supplies.

Market surveys are being made with a view to collecting facts and developing methods for bringing useful information in regard to prices and supplies promptly to producers and consumers. The practise in vogue in marketing and distribution in large cities is the subject of a special inquiry, to make comparisons and arrive at the most advantageous plans. Direct dealing through marketing by parcel post and by express is being studied, not only as to practicability and advantages, but as to systems for bringing producers and consumers into contact and establishing their business relationships. Cooperative buying and selling naturally attracts considerable attention, with inquiry into the methods and success of organizations, and the supplying of assistance in organization, systems of accounting, auditing, etc.

The partial enumeration of these lines of effort illustrated some of the problems in marketing. From a consideration of cotton handling and marketing, Mr. Brand showed that the acute problems are not confined to perishable crops. The cantaloupe trade was cited to show an overdevelopment of the industry, due to ignorance as to the development of competitive areas, which in 1914 resulted in disaster to the producers and to the large distributors. As usual, the slump in prices was not reflected in the retail trade, consumers paying practically as much as in a year of scarcity, while the surplus went to the dump. The conclusion is that "until we have a more complete system of information and a better adjustment of production to market requirements, this problem will continue to be with us."

Cooperation was not regarded as necessarily the panacea for all marketing troubles. Organization was favored, but alone it is not sufficient; it must be accompanied by skilful and intelligent management. To protect shippers from imposition and misrepresentation at large markets and terminals, a licensed inspection system was suggested, and illustrations of the use it could serve were cited.

"The Distinction Between Efficiency in Produc-

tion and Efficiency in Bargaining" was well illustrated by Dr. T. N. Carver, of Harvard University. He explained that every legitimate business is made up of two parts, one of which may be called producing, including any handling of the material which renders it more usable or useful, and the other bargaining, *i. e.*, buying and selling, borrowing and lending. Many of the supposed economies of large-scale business turn out upon examination to be advantages in bargaining rather than economies in production. In most lines of business there is a certain size which gives the maximum efficiency in production, and also in bargaining. These do not necessarily coincide, but as a rule, the size which gives the maximum efficiency in bargaining is larger than that for production.

In agriculture the most efficient producing unit was said to be the one-family farm, provided with the best teams, tools and general equipment. This gives the highest average product, man for man. If the large farmer is able to command some special advantages in securing cheap labor, he may beat the small farmer in competition with him, but this is advantage in bargaining. His profit may be larger, in spite of the lower average productivity of the persons engaged. The foisting upon the rural districts of a large supply of cheap labor is designed to give the large farmer an advantage in purchasing his labor.

Again, it was pointed out that in buying his supplies and in selling his products, especially if they are perishable, the large farmer usually has an advantage. "The small farmer of the present day is the only large class which regularly buys its raw material at retail and sells its finished product at wholesale." This can be overcome by "collective bargaining" or cooperation, which may give the small farmer the same advantages which the large farmer enjoys; and the same is true in borrowing capital. Hence for the small farmer, who appears to be efficient in production, organization into larger units was urged, to overcome inefficiency in buying and selling.

Dean E. Davenport, of the University of Illinois, was elected vice-president and chairman of the section for the ensuing year, Dr. A. C. True, of the Office of Experiment Stations, was chosen member of the General Committee of the Association; Dr. W. A. Taylor, of the Bureau of Plant Industry, member of the council, and President Kenyon L. Butterfield, of Massachusetts, a member of the sectional committee (for five years).

E. W. ALLEN,  
*Secretary*